Adapting to Wisconsin’s Changing Waters

Tim Asplund, WDNR Lakes and Wetlands Section Co-Chair, WICCI Water Resources Working Group
WAPA, March 9, 2011
"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level."

IPCC, 2007
One of many signs of warming in Wisconsin...

Decrease in duration of ice cover on lakes

Source: J. Magnuson, UW-Madison
Fallison Lake, Vilas County
Crystal Lake groundwater flooding
Extreme events: June 2008 storms

- Stormwater infrastructure was overwhelmed
- Massive flooding (810 sq. mi)
- Water from private wells contaminated (28%)
- Raw sewage overflows (90 million gallons from 161 wastewater treatment plants)
- FEMA paid $34 million in flood damage claims

Few communities even today can handle these kinds of extreme events!

... and such events are projected to become more frequent in a warming climate.
Should we call it “Global Weirding”?

“I prefer the term 'global weirding,' coined by Hunter Lovins, co-founder of the Rocky Mountain Institute, because the rise in average global temperature is going to lead to all sorts of crazy things — from hotter heat spells and droughts in some places, to colder cold spells and more violent storms, more intense flooding, forest fires and species loss in other places.”

THOMAS L. FRIEDMAN – NY Times
Published: February 17, 2010
WICCI’s First Adaptive Assessment Report - released Feb 2011

30+ Authors
10 Editorial Team Members
22 Science Council Members
22 Chairs/Co-Chairs of 15 Working Groups
220 Working Group Members

http://wicci.wisc.edu
WICCI
Identifying impacts and adaptation strategies

Mission:
Assess and anticipate climate change impacts on specific Wisconsin natural resources, ecosystems and regions.

Evaluate potential effects on industry, agriculture, tourism, and other human activities.

Develop and recommend adaptation strategies.

www.wicci.wisc.edu
WICCI was created by a partnership of the UW-Madison Nelson Institute for Environmental Studies and the Wisconsin Department of Natural Resources.
Observed Change in Average Temperatures °F from 1950 to 2006

Winter temperatures have warmed more than any other season in recent decades, especially in northwestern Wisconsin.

(from Serbin and Kucharik 2009)
Summary of recent **historic** climate
1950-2006 (based on NWS records)

**Change in annual average precipitation** (inches) 1950 to 2006

↑ 7” to ↓ 4” (drought)

**Increase in 2” rainfalls** (days/decade) 1950 to 2006

↑ 3.5 days to ↓ 1.5 days (regionally variable)
WICCI Climate Working Group

- Used 14 General Circulation Models (GCM’s) from IPCC 2007 assessment
- Verified using historical Wisconsin weather station data
- Result: a statistical range of probable climate change

**Downscaling:** Focus global projections to a scale relevant to climate impacts in Wisconsin

D. Vimont, UW-Madison
Annual Temperature Change

Wisconsin will warm by 4 – 9 °F by mid-21st Century

Projected Change in Annual Average Temperature (°F) from 1980 to 2055

Source: Center for Climatic Research & Center for Sustainability and the Global Environment, Nelson Institute, University of Wisconsin-Madison

Probability Distribution of 14 Global Climate Model Projections

90% chance of exceeding this temperature
10% chance of exceeding this temperature
50% probability temperature (plotted on maps)

Source: Adapted from D. Vimont, UW-Madison
Projected Change in Precipitation from 1980 to 2055

Models predict winter and early spring will be wetter (0-40% increase).

Models uncertain about amount of summer rainfall.
Number of days with intense precipitation is projected to increase across Wisconsin in 21st century.

- Roughly a 25% increase in frequency.
- Recurrence intervals decrease from once every 10 months to once every 8 months in southern Wisconsin.
- Once every 17 months to once every 14 months in northern Wisconsin.
Increase in Intense Precipitation

Increasing in frequency

Moderate increase in intensity

Change in Heavy Precipitation Days (Wisconsin Average)

Change in Intensity of Annual Maximum Daily Precip Amount (Wisconsin Average)

Steve Vavrus
Warming results in more rainfall in winter

Percent Precipitation as Rain
Madison, WI 1961-2000 and 2046-2065

<table>
<thead>
<tr>
<th>Month</th>
<th>Historical (in)</th>
<th>Future (in)</th>
<th>% Change</th>
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<tbody>
<tr>
<td>January</td>
<td>0.24</td>
<td>0.65</td>
<td>174.8%</td>
</tr>
<tr>
<td>February</td>
<td>0.35</td>
<td>0.72</td>
<td>107.6%</td>
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<tr>
<td>March</td>
<td>1.21</td>
<td>1.83</td>
<td>60.8%</td>
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<tr>
<td>April</td>
<td>3.00</td>
<td>3.42</td>
<td>13.9%</td>
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<tr>
<td>May</td>
<td>3.37</td>
<td>3.48</td>
<td>3.4%</td>
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<tr>
<td>June</td>
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<td>-0.1%</td>
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<tr>
<td>July</td>
<td>3.95</td>
<td>3.88</td>
<td>-1.5%</td>
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<tr>
<td>August</td>
<td>4.01</td>
<td>3.89</td>
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<tr>
<td>September</td>
<td>3.44</td>
<td>3.42</td>
<td>-0.5%</td>
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<tr>
<td>October</td>
<td>2.37</td>
<td>2.66</td>
<td>12.4%</td>
</tr>
<tr>
<td>November</td>
<td>1.63</td>
<td>2.02</td>
<td>24.3%</td>
</tr>
<tr>
<td>December</td>
<td>0.54</td>
<td>1.11</td>
<td>105.3%</td>
</tr>
</tbody>
</table>
Major Drivers of Climate Change

Impacts on Water Resources

- Thermal Impacts (Increased air and water temps, longer ice-free period, more ET)
- Changing rainfall patterns (seasonal and spatial variability, + or – water, less precip in the form of snow)
- Increased storm intensity (more frequent large precipitation events)
Areas of uncertainty

- Timing, amount, and form of spring precipitation events relative to spring thaw

- Balance between increased precipitation and increased evapotranspiration on groundwater recharge, and subsequently lake levels and stream baseflows

- Short term (years to decades) vs long term (decades to century) processes
“Stationarity is dead.” Science 2008

“Traditionally, hydrologic design rules have been based on the assumption of stationary hydrology, tantamount to the principle that the past is the key to the future…

…This assumption is no longer valid.”

Kundzewicz et al 2007. Contribution of Working Group II to IPCC
Historic occurrences of intense rainfall

Note low frequency in east-central

Are these communities prepared for >100 year events?
Adaptation!

So where do we go from here?
Adaptation: “- adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.” IPCC

Risk management is the framework to discuss adaptation to climate change impacts.

Risk = (probability of impact occurring) X (degree of harm or benefit)
Key Water Resource Impacts

- Increased flooding
- Increased frequency of harmful blue-green algal blooms
- Conflicting water use concerns
- Changes in water levels
- Increased sediment and nutrient loading
- Increased spread of aquatic invasive species
Adaptation Goals for Water Resource Management

- Minimize threats to public health and safety by anticipating and managing for extreme events (floods and droughts)
- Increase resiliency of aquatic ecosystems to buffer the impacts of future climate changes
- Stabilize future variations in water quantity and availability by managing water as an integrated resource
- Maintain, improve, and restore water quality under a changing climate regime
Potential Adaptation Strategies

**Strategy**: Respond to *increased flooding* and impacts to infrastructure and agricultural land

- Identify and map and prioritize Potentially Restorable Wetlands (PRW’s) in floodplain areas
- Restore prior-converted wetlands in upland areas to provide storage and filtration
- Resize manure storage lagoons, wastewater facilities, storm sewers, etc to accommodate increased storm flows
- Inspect, reinforce or remove dams, water control structures

*Photos - WDNR*
Areas in red show overlap between PRWs and 100 year floodplain.

Note: floodplain delineations not complete for some counties.
Adaptation

Vulnerability assessment

“Build upon the experiences of communities that have experienced recent extreme rainfalls to guide a state-wide evaluation of vulnerabilities…..”
- WICCI Stormwater Working Group

Assess:

• Floodplains and surface flooding
• At-risk road-crossings
• Stormwater BMPs
• Emergency response capacity
• Wells and septic systems
• Hazardous materials storage
Buildings, roads and water/sewer systems are not currently designed for challenges from future climate changes.

WICCI Stormwater Working Group
Adaptation

SSO and CSO

• Disconnect stormwater inputs
• Tighten systems to prevent infiltration
• Provide temporary storage
• Educate homeowners
  Runoff inflow
  Sump pump discharge
• Plan for extreme events
Potential Adaptation Strategies

Strategy: Response to increasing groundwater extraction and demand for water

- Encourage large water users to locate in areas with adequate (sustainable) water sources (e.g. large rivers/Great Lakes).
- Encourage water conservation (rural and urban) through incentives and regulation.
- Promote Integrated Water Management: Planning water use based on long term projections of supply and demand.
Groundwater Management Areas!

Kraft & Mechenich, 2010
Consensus Statement

“Our working group cautions that not all portions of Wisconsin are expected to respond in a similar manner in hydrologic responses to climate change.”

Differences in state:
- Climate projections
- Land Use
- Soil type/surface deposits
- Groundwater characteristics
- Runoff/seepage
What’s Next for WICCI?

- WICCI report online – February 2011
- WDNR embarking on natural resources adaptation planning effort
- Outreach and education activities
- Adaptive management workshops
- Facilitate new working groups and collaborative efforts
- Working toward 2nd adaptive assessment!